Journal of Horticulture
ISSN: 2376-0354
OPEN ACCESS Freely available online
Review Article

# Leaf Yield of Cow Pea (*Vigna unguiculata*) as Influenced by Harvesting Regimes under Greenhouse Conditions

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## ABSTRACT

Cowpea is an economically and nutritionally important vegetable crop widely cultivated by smallholder farmers both for subsistence and income generation. Uprooting the entire plant as a form of harvest is common in on-field subsistence farming systems. However, little is known about the effect of harvesting regimes on total productivity of cowpea under greenhouse conditions. This study was conducted with an objective of evaluating growth and yield of cowpea in response to different harvest regimes under controlled conditions. Plots of cowpea stands/clusters each with four plants were subjected to three different treatments, i.e., harvest 1 (H1), harvest 2 (H2), and harvest 3 (H3) in a randomized complete block design. Overall crop yield was measured by the number of leaves and Plant Height (PH) at 7-day intervals. Data collection was initiated at week 1 and week 2 after emergence. The results revealed significant differences in both PH and NTL between H0 and H1, H2, or H3 ($p \leq 0.05$), implying that cowpea yields can be significantly improved by applying harvesting regimes to vegetable-only production systems. For PH, maximum values were obtained for H1 and H3. Thus, farmers can obtain higher vegetable productivity by harvesting cowpea for consumption or sale at intervals, as opposed to a one-time mass harvesting.

**Keywords:** Harvesting regimes; M66 variety; Productivity

## INTRODUCTION

Cowpea, is a food legume of the family Fabaceae/Papilionaceae. All cultivated cowpeas are grouped under the species *Vigna unguiculata* with seed size and color, taste, yield, and maturity time being the primary physiologic varietal differentiators. The plant is an herbaceous legume showing considerable adaptation to warm climates with adequate rainfall and is cultivated across Southeast Asia, Africa, Southern United States and Latin America [1]. Cowpea is also traditionally cultivated in some Mediterranean countries. It is a major grain legume grown in semi-arid regions of Sub-Saharan Africa. Because of its high proteins, vitamins and minerals contain, cowpea plays an important role in human consumption and animal feeding. Cowpea leaves and green pods are consumed as vegetable and the dried grain is used in many different food preparations [2].

In dual-purpose production, the leaf harvests are made during the vegetative stage before pod formation. Where the crop is cultivated purely for vegetable production, the whole plant with 3-5 true leaves is uprooted when the leaves are tender and less fibrous. The latter system is a predominant practice, which influences subsequent productivity of remnant cowpea crops. However, there is a paucity of information on the effect of harvesting regimes on subsequent vegetable yield of the remaining plants under greenhouse conditions. Greenhouse production has the potential to double yields due to lower exposure to pests/diseases and bad weather as well as reduced production costs and off-season production. Thus, characterizing the cowpea crop for greenhouse microclimate is required to produce nutritionally and commercially high-quality leaf yields [3]. The purpose of this study was, therefore, to identify the vegetative growth and development) changes under greenhouse conditions in response to harvesting intervals. Specifically, the

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**Received:**06-Sep-2022, Manuscript No. JOH-22-22331; **Editor assigned:** 08-Sep-2022, PreQC No: JOH-22-22331 (PQ); **Reviewed:** 22-Sep-2022, QC No: JOH-22-22331; **Revised:** 29-Sep-2022, Manuscript No: JOH-22-22331(R). **Published:** 06-Oct-2022; DOI:10.35248/2376-0354.22.9.310

**Citation:** Odhiambo H, Wasilwa L, Maangi J (2022) Leaf Yield of Cow Pea (Vigna unguiculata) as Influenced by Harvesting Regimes under Green house Conditions. J Hortic. 9:310.

study sought to evaluate growth and yield of cowpea (M66 variety) in response to different harvest regimes under controlled (greenhouse) conditions [4].

# MATERIALS AND METHODS

## Plant material

A popularly cultivated cowpea variety in Western Kenya, M66, was used in this research. M66 is a determinate, dual-purpose cultivar characterized by extensive vegetative growth and drought resistance. The cowpea seeds for planting were procured from the local open-air market.

## Experimental design and treatments

The experimental design was randomized complete block design (RCBD) with three replicates and three treatments/harvesting regimes: harvest 1 crop (H1); harvest 2 crops (H2); and harvest 3 crops (H3) and a control. Harvesting (uprooting the entire plant) was initiated at 2 weeks after emergence (formation of 4-5 true leaves) and was done at a frequency of 14-day intervals until all plants in a cluster were harvested. In the RCBD, individual plots in a block measured 6m by 0.5m with a 1m separation buffer. Data were collected from 12 plants from 3 tagged monocrop clusters, and not all the plants in non-control plots. The parameters measured were (1) plant height (PH) and later (2) Number of Trifoliate Leaves (NTL) after the emergency of trifoliate leaves [5].

## Crop establishment and agronomic practices

The M66 cowpea cultivar seeds were planted in clusters of four seeds at each drip-nozzle at a cluster-to-cluster spacing of 30cm x 50cm in two rows within each plot. No fertilizer was applied in the plots before, during, or after planting. Drip irrigation was undertaken at a 2-day intervals, ensuring adequate soil moisture availability. Routine hand-weeding was uniformly applied to all plots. The crops were free from pests and diseases, thus, no spraying was necessary [6].

## Data collection

Growth and development data of the cowpea were collected on two parameters; plant height (PH) and later Number of Trifoliate Leaves (NTL). PH was measured on the entire above-ground shoot (i.e., base of the stem to the tip of the youngest leaf) and was initiated at week one after germination. PH was obtained from each of the four plants in a cluster in each treatment and continued for the entire data collection period. NTL was obtained by counting the number of true leaves and was initiated at week two after the emergence of trifoliate leaves. All true leaves (an indicator of productivity per unit area) were counted except the apical bud [7].

# STATISTICAL ANALYSIS

Data collected were subjected to analysis of variance ($P \leq 0.05$) or one-way ANOVA using the SPSS software to determine within- and between-group differences in means of PH and NTL. Harvesting initiation time and interval were consistent for all treatments. Therefore, the effect of harvesting regimes (H0, H1, H2, and H3) on cowpea growth and development was determined based on the significant differences in PH and NTL amongst the treatments [8].

# RESULTS

The average plant height (PH) was not significantly different between any of the four treatments (n=36) in two consecutive weeks after germination. PH averaged 16.2cm and 27.1cm at week 2 and 3. However, NTL was significantly different in treatments H0/H1 and H0/H2 at week 2 when counting of trifoliate leaves was initiated (mean=2.6). Mean NTL and PH difference was significant ($p \leq 0.05$) at week 3 through 5, when the harvesting regimes were applied to the plots, as summarized in Table 1 below.

| Parameter | Week | Treatment (I) | Treatment (J) | Significance |
|---|---|---|---|---|
| NTL | Week 3 | H0 | H1 | 0.02 |
| | | | H2 | 0.02 |
| | | | H3 | 0.05 |
| | Week 4 | H0 | H3 | 0.015 |
| | Week 5 | H0 | H1 | 0.021 |
| PH | Week3 | H0 | H1 | 0.012 |
| | | | H3 | 0.034 |
| | Week 4 | H0 | H3 | 0.009 |
| | | H1 | H3 | 0.021 |
| | Week 5 | H0 | H1 | 0.01 |

**Table 1:** Significant differences amongst harvesting regimes ($p \leq 0.05$).

NTL increased for all treatments from week 3 to week 5 when the final harvesting was completed, as shown in Figure 1.

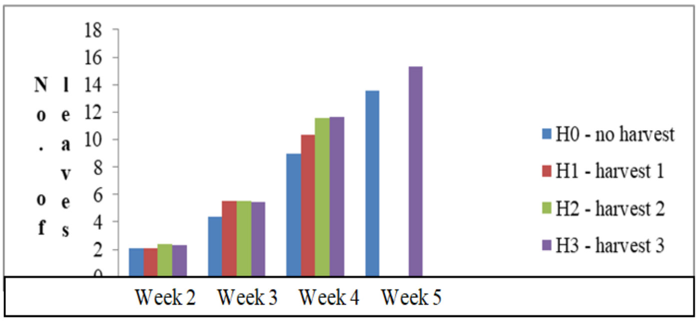


**Figure 1:** No. of leaves from week 2 to 5.

# DISCUSSION

Increased cowpea production has the potential of meeting the nutritional requirements of the growing population and resource-poor households. Cowpea leaves are high in protein (27-43%), vitamins, and minerals. The realization of the full potential associated with whole-plant harvesting for vegetables remains low due to limited information on the harvesting regime that would give optimal overall productivity per unit area of land.

## Number of trifoliate leaves

Results from this research indicate that cowpea vegetable yields are influenced by harvesting regime. Four to five young, tender consumable true leaves are harvested by uprooting the plant hence, a strong predictor of crop productivity or yield. In week 2, the mean differences in NTF were not significant prior to applying the harvest regimes. However, between-group mean difference in NTF was significant in week 3-5. The average number of leaves was lowest in H0 (no harvest) treatment at 2, 4, 9, and 14 in week 2, 3, 4, and 5, compared to the other three treatments: H1 (2, 6, and 10 leaves), H2 (2, 6, and 12 leaves), and H3 (2, 5, 11, and 15 leaves) over the same intervals. Since the water was not a limiting factor under greenhouse conditions, it implies that harvesting one, two, and three plants per stand increased vegetative growth rate in the remaining plants in a cluster. Since during sequential harvests, one, two, or three plants were uprooted from a cluster, unlike in controls (no harvest), competition for nutrients, space, and light was reduced, increasing vegetative growth. This finding is consistent with the agronomic practices of thinning and defoliation to reduce overcrowding and maintain fewer strong plants that would guarantee better yields. However, in this study, the average number of leaves did not vary significantly in H1H2, H1H3, or H2H3 comparison dyads. Adequate spacing may account for the low variation in leaf number between these treatments.

## Plant height

Cowpea plant height is another measure of productivity since the entire shoot, including the leaf stalks, lateral leaves, and bud, is consumed as vegetable or animal feed. Again, a lack of harvesting was found to reduce yield, in terms of average plant height. Mean PH was significantly higher in H1, H2, and H3 than in H0 in week 3-5 when the harvesting regimes were applied. The difference was highest between H0 (34.4 cm) and H3 (37 cm) and between H0 (34.4 cm) and H1 (0.012 cm) in week 3 ($p \leq 0.05$). At this time, the crop was at the exponential phase of growth and therefore, harvesting or thinning increased growth of the remaining plants due to diminished competition for nutrients and light. Additionally, the height difference between H1 (81.9 cm) and H3 (64.9 cm) was significant at week 4. While H3 (three plants harvested) was expected to have higher growth than H1 (one plant harvested), differences in nutrient composition between beds could explain this outlier. The average height in H3 was 64.9 cm, lower than H2 at 81.9 cm in week 4. Nevertheless, overall, cowpea height increased when more plants were thinned from a cluster, as height in H1 (81.9 cm) and H4 (79.9 cm) were higher than in H0 (65.7 cm) at week 4. In week 5, H3 also exceeded H0 in height (152.6 cm vs. 142.6 cm). This implies that harvesting regimes increases significant vegetative yield of the remaining plants when compared to controls and maximum yields can be obtained by harvesting 1 or three plants at each interval.

# CONCLUSION

Cowpea is an economically and nutritionally important vegetable or dual-production crop. However, its commercial potential can be fully harnessed if optimal harvesting regimes are applied under greenhouse conditions. The findings of this study suggest that the number of plants harvested by uprooting from a pure stand affects the yield (plant height and number of leaves) of the remaining plants. Significant differences in NTL and PH were found between H0 (control) and H1, H2, or H3 but not between controls ($p \leq 0.05$). The harvesting regimes reduced competition for nutrient and light between plants, resulting in maximal photosynthetic output and growth. Therefore, based on the findings of this study, an economic analysis would suggest that farmers can obtain maximum returns by harvesting one or three crops at 7-day intervals for sale.

# REFERENCES

1. Gelder AD, Dieleman JA, Bot GA, Marcelis LF. An Overview of Climate and Crop Yield In Closed Greenhouses. J Hortic Sci Biotech. 2012;87(3):193-202.
2. Craine JM, Dybzinski R. Mechanisms of plant competition for nutrients, water, and light. Funct Ecol. 2013;27(4):833-840.
3. Gonçalves A, Goufo P, Trindade H, Rosa E, Ferreira L, Dominguez-Peris R. Cowpea (Vigna unguiculata L. Walp), a renewed multipurpose crop for a more sustainable Agri-food system: Nutritional advantages and constraints. J Sci Food Agric. 2016;96(9): 2941–2951.
4. Saidi M, Itulya FM, Aguyoh JN, Ngouajio M. Effects of Cowpea Leaf Harvesting Initiation Time and Frequency on Tissue Nitrogen Content and Productivity of a Dual-Purpose Cowpea–Maize Intercrop. Hortscience. 2010;45(3):369-375.
5. Puente L, Pinto-munoz CA, Castro ES, Cortes M. Physalis peruviana Linnaeus, the multiple properties of a highly functional fruit: A review. Food Res Int. 2011;44(7):1733-1740.
6. Mota RV. Characterisation of black-berry juice prepared in a domestic extractor. Food Sci Technol. 2006;26(2):303-308.
7. Sola AJ, Ehrlen J. Vegetative phenology constrains the onset of flowering in the perennial herb Lathyrus vernus. J Ecol. 2006;95(1):208-216.
8. Malla AA, Sharma RM, Singh AK, Masoodi FA. Propagation and pinching studies in cape gooseberry (Physalis peruviana L.). J Res. 2008;7:128-139.